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[Number of claim] 7
[Inventor]
[Address]
[Name] Akihiro Nagata
[Inventor]
[Address]
[Name] Toshiaki Aragane
[Inventor]
[Address]
[Name] Takashi Hamada
[Inventor]
[Address]
[Name] Yoshiki Matsuura
[Applicant]
[Register Number] 000006068
[Zip Code] 653
[Address] No.1-21, 4-chome, Hamazoe-dori, Nagata-ku, Kobe, Hyogo, Japan.
[Name] Mitsuboshi Belting Ltd.
[Representative] Norio Nishikawa
[Indication of Fee]
[Means of Pay] Prepayment
[Account Number] 010412
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[document]	Specification	1
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[Name of the Document] SPECIFICATION

[Title of the Invention]

METHOD FOR VULCANIZING BELTS, AND METHOD FOR PRODUCING
BELT SLEEVES

[Claims]

1. A method for vulcanizing belts, which comprises vulcanizing an unvulcanized belt sleeve comprising at least a compressible rubber layer and an expansive rubber layer, with the belt sleeve being fixed around the outer peripheral surface of a mold, and which is characterized in that at least the outer peripheral surface of the unvulcanized belt sleeve being fixed around the mold is surrounded by a vapor-impervious film, then the mold is set in a vulcanizer, and the belt sleeve is vulcanized while being airtightly sealed by the film.

2. The method for vulcanizing belts as claimed in claim 1, in which the vapor-impervious film is a synthetic resin film.

3. The method for vulcanizing belts as claimed in claim 1, in which the vapor-impervious film is wound around the outer peripheral surface of the unvulcanized belt sleeve and over a part of the both ends of the mold.

4. The method for vulcanizing belts as claimed in claim 1 or 3, in which a sealing material is applied onto the vapor-impervious film partly at the upper and lower corners of the unvulcanized belt sleeve.

5. The method for vulcanizing belts as claimed in claim 4, in which the sealing material is an at least single-layered, rubber-impregnated canvas.

6. A method for vulcanizing belts, which comprises vulcanizing an unvulcanized belt sleeve comprising at least a compressible rubber layer and an expansive rubber layer, with the belt sleeve being fixed around the outer peripheral surface of a

mold, and which is characterized in that a synthetic resin film is wound around the outer peripheral surface of the unvulcanized belt sleeve and over a part of the both ends of the mold to thereby surround at least said outer peripheral surface of the unvulcanized belt sleeve, then a sealing material is applied onto the synthetic resin film partly at the upper and lower corners of the unvulcanized belt sleeve, thereafter the mold is set in a vulcanizer, and the belt sleeve is vulcanized while being airtightly sealed by the film.

7. A method for producing belt sleeves for power transmission belts, which comprises forming a belt sleeve comprising a compressible rubber layer, a core and an expansive rubber layer, around the outer peripheral surface of a mold followed by vulcanizing it, and which is characterized in that at least the outer peripheral surface of the belt sleeve being fixed around the mold is surrounded by a vapor-impervious film, then the mold is set in a vulcanizer and the belt sleeve is vulcanized while being airtightly sealed by the film, and finally the film is removed after the vulcanization.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a method for vulcanizing belts and to a method for producing belt sleeves, and, more precisely, it relates to a method for vulcanizing belts, such as V-ribbed belts and toothed belts, and a method for producing belt sleeves for those belts, in which no jacket is used during vulcanization without introducing any bubbles in the vulcanized belt sleeves.

[0002]

[Prior Art]

In one conventional method for vulcanizing belts, an unvulcanized belt sleeve comprising a laminate of a compressible rubber layer, an expansive rubber layer and an adhesive rubber layer being sandwiched between the former two layers, and a core as embedded in the adhesive rubber layer is fitted around the outer peripheral surface of a mold; then an elastically-deformable, cylindrical jacket is concentrically fitted over the belt sleeve; the mold having the belt sleeve therearound in that condition is mounted on a supporting stand via an elastic packing material therebetween in a vulcanizer, the supporting stand being positioned in the lower part of the vulcanizer; then the top end of the mold is covered with a cover; and the unvulcanized belt sleeve is vulcanized in the vulcanizer with applying high-pressure vapor over the jacket and low-pressure vapor into the mold (drum).

[0003]

In the conventional method, the high-pressure vapor applied over the jacket presses the jacket against the unvulcanized belt sleeve to thereby expel air from the space between the jacket and the mold, while the unvulcanized belt sleeve is vulcanized and solidified to have a predetermined shape. It is said that the thus-vulcanized belt sleeve is stiff and has good quality without containing air bubbles.

[0004]

To prepare the jacket to be used in the conventional method, for example, an unvulcanized rubber layer having a predetermined thickness is wound around a mold and shaped into a jacket body, then a flange of unvulcanized rubber extending outward is fitted to at least one end of this body, and a different cylindrical jacket is fitted into this body, which is then vulcanized in a vulcanizer, and thereafter the thus-formed jacket is released from the mold.

[0005]

[Problems to be Solved by the Invention]

However, the conventional method for vulcanizing belts is problematic in that a plurality of rubber jackets must be prepared and stored all the time for belts of different sizes, and those rubber jackets require a large space in factories. In addition, where belts of particular sizes are produced, the frequency of using jackets for those belts is small so that the jackets used must be visually inspected every time after their use.

[0006]

Further, in ordinary assembly lines of producing belts where unvulcanized belt sleeves of different sizes are conveyed in undefined sequence, a jacket fittable to the just-conveyed belt sleeve must be picked up within a short period of time and must be fitted into the belt sleeve without delay. In fact, however, the picking out of the just-fittable jacket in various jackets of different sizes and the exchange of jackets inevitably limit the production

line and even cause loss of time for changing the production line.

[0007]

Moreover, in order to prevent vapor leakage through jackets that causes penetration of vapor into unvulcanized belt sleeves through jackets, special control of jackets is inevitable. For example, jackets being used for a long period of time must be carefully checked all the time as to whether or not the both flanges and the inner surface have been deteriorated, as to whether or not any dust has been adhered to the both flanges, and as to whether or not the body length and the circumference length have changed, and good jackets with no problem in those points must be used all the time. If not, and if bad jackets are used, vapor leaks through the jackets being used, resulting in that bad belt sleeves containing air bubbles therein are produced through the vulcanization.

Furthermore, when jackets being used are exchanged for new ones, the new jackets must be fully pre-heated in the vulcanizer prior to being applied to unvulcanized belt sleeves so that the jackets are expanded to be in good size for the body length and the circumference length being fittable to the unvulcanized belt sleeves.

[0008]

The present invention is to solve those various problems inevitable in the conventional vulcanization method requiring jackets, and its object is to provide a method of jacketless vulcanization for belts and a method

for producing belt sleeves without using jackets, which are advantageous in that the space for the production lines is reduced, that the loss of working time is reduced, that the cost for the vulcanization is reduced, and that high-quality belt sleeves containing no bubbles are obtained with no vapor leakage.

[0009]

[Means for Solving the Problems]

Specifically, the invention of claim 1 is a method for vulcanizing belts, which comprises vulcanizing an unvulcanized belt sleeve comprising at least a rubber layer with a mold being fitted into the belt sleeve, and which is characterized in that at least the outer peripheral surface of the unvulcanized belt sleeve being fixed around the mold is surrounded by a vapor-impervious film, then the mold is set in a vulcanizer, and the belt sleeve is vulcanized under the condition that being airtightly sealed by film. In this method, since the outer peripheral surface of the unvulcanized belt sleeve is surrounded by a vapor-impervious film, and since the film prevents the penetration of vapor into the belt sleeve being vulcanized, the unvulcanized belt sleeve can be vulcanized without using any jacket. Therefore, this method is suitable for small-space production lines, while reducing the loss of working time and reducing the cost for vulcanization.

[0010]

In the invention of claim 2, which is dependent on claim 1, a synthetic resin film is used as the vapor-impervious film. In this, the synthetic resin film is easily wound around the outer peripheral surface of the unvulcanized belt sleeve to surround it.

[0011]

In the invention of claim 3, which is dependent on claim 1, the vapor-impervious film is wound around the outer peripheral surface of the unvulcanized belt sleeve and over a part of the both ends of the mold. In this, even the upper and lower corners of the unvulcanized belt sleeve are surely surrounded by the film, whereby the belt sleeve being vulcanized is more surely protected from vapor penetration thereinto.

[0012]

In the invention of claim 4, which is dependent on claim 1 or 3, a sealing material is applied onto the vapor-impervious film partly at the upper and lower corners of the unvulcanized belt sleeve. In this, the belt sleeve being vulcanized is much more surely protected from vapor penetration thereinto through its upper and lower corners.

[0013]

In the invention of claim 5, which is dependent on claim 4, the sealing material is a fibrous one selected from at least single-layered, rubber-impregnated canvas and non-woven fabric. In this, the upper and lower corners of the belt sleeve being vulcanized are more surely sealed.

[0014]

The invention of claim 6 is a method for vulcanizing belts, which comprises vulcanizing an unvulcanized belt sleeve comprising at least a rubber layer with a mold being fitted into the belt sleeve, and which is characterized in that a synthetic resin film is wound around the outer peripheral surface of the unvulcanized belt sleeve and over a part of the both ends of the mold, then a sealing material is applied onto the synthetic resin film partly at the upper and lower corners of the unvulcanized belt sleeve, thereafter the mold is set in a vulcanizer, and the belt sleeve is vulcanized under the condition that being airtightly sealed by the film. In this, the synthetic resin film used surely surrounds the outer peripheral surface of the unvulcanized belt sleeve and even the upper and lower corners thereof, and, in addition, the upper and lower corners of the belt sleeve are more surely sealed with the sealing material. This method is advantageous in that the application of the synthetic resin film and the sealing material to the vulcanized belt sleeve can be effected with ease. In addition, this method is suitable for small-space production lines, while reducing the loss of working time and reducing the cost for vulcanization.

[0015]

The invention of claim 7 is a method for producing belt sleeves for power transmission belts, which comprises forming a belt sleeve comprising at least a rubber layer and a core around the outer peripheral surface of a mold followed by vulcanizing it, and which is characterized in

that at least the outer peripheral surface of the belt sleeve being fixed around the mold is surrounded by a vapor-impervious film, then the mold is set in a vulcanizer and the belt sleeve is vulcanized under the condition that being airtightly sealed by the film, and finally the film is removed after the vulcanization. In this method, the belt sleeve can be vulcanized without using any jacket, and the vulcanized belt sleeve does not contain any bubbles. The belt sleeve produced in this method can be used in forming V-ribbed belts, toothed belts and others.

[0016]

[Modes of Carrying out the Invention]

Now, the method for vulcanizing belts of the invention is described in detail hereinunder with reference to the accompanying drawings.

Fig. 1 is a view illustrating the formation of an unvulcanized belt sleeve comprising a compressible rubber layer, a core and an expansive rubber layer, on a mold. First, a mold (drum) 1 is set in a shaping machine (not shown); one or several sheets of reinforcing fabric 2, an unvulcanized rubber sheet 3 which is to be an expansive rubber layer, and an unvulcanized rubber sheet 4 which is to be an adhesive rubber layer are wound around the drum 1; a core 5 of a cord of polyester fiber, aramide fiber, glass fiber or the like is spun thereover; and thereafter an unvulcanized rubber sheet 6, which is to be a compressible rubber layer, is wound over the core 5. In this shaping process, the compressible rubber layer is in the outermost

position. Therefore, this process is generally referred to as an inverse-shaping process.

[0017]

The unvulcanized rubber sheets 3 and 6, which are to be an expansive rubber layer and a compressible rubber layer, respectively, are composed of a rubber material, such as natural rubber, butyl rubber, styrene-butadiene rubber, chloroprene rubber, ethylene-propylene rubber, alkylated chlorosulfonated polyethylene, hydrogenated nitrile rubber, and a mixed polymer of hydrogenated nitrile rubber and a metal salt of an unsaturated carboxylic acid, or a mixture of those rubber materials, and short fibers of, for example, para-aramide fiber (trade name: XXX, XXXX, XXXXX), nylon, polyester, vinylon or cotton, in which the short fibers are oriented in the direction of the width of the belt. The amount of the short fibers to be added may be from 5 to 40 parts by weight relative to 100 parts by weight of rubber.

The adhesive rubber layer may contain those short fibers, but preferably does not contain them.

[0018]

The reinforcing fabric 2 is made of cotton, polyester fiber, nylon or the like, and is woven in plain weave, twill weave, satin weave or the like. This may be wide-angle canvas in which the weft and the warp intersect at a wide angle of from 90 to 120 degrees or so. The reinforcing fabric 2 is, after having been processed with RFL, coated with a rubber composition through friction

coating to be rubber-impregnated canvas. RFL is a mixture of resorcinol-formalin precondensate with latex, in which the latex may be any of chloroprene, styrene-butadiene-vinylpyridine terpolymer, hydrogenated nitrile, NBR, etc.

[0019]

Fig. 2 is a view illustrating the application of a vapor-impervious film 8 onto the outer peripheral surface 9 of the unvulcanized belt sleeve 7 formed around the mold 1, in which the belt sleeve 7 is being surrounded by the film 8. As in this, the vapor-impervious film 8 is spirally wound around the outer peripheral surface 9 of the unvulcanized belt sleeve 7 fitted over the mold 1, which was taken out of the shaping machine, and partly over the both ends 10 of the mold 1. In this step, the film 8 being spirally wound around the unvulcanized belt sleeve 7 must overlap with the underlying one at their ends in order that the belt sleeve 7 is not exposed. Needless-to-say, a plurality of films 8 may be wound around the belt sleeve 7. Preferably, from 2 to 4 films 8 are wound around it.

The film 8 may be a wide one. Such a wide film 8 is not spirally wound around the belt sleeve 7 but may be singly wound around it.

[0020]

The unvulcanized belt sleeve 7 thus surrounded by the film 8 is, as in Fig. 3, such that the film 8 covers not only the outer peripheral surface 9 of the belt sleeve 7 but also a part of the both ends 10 of the mold 1 to thereby surround the corners 12 of the mold 1. In that

condition, the film 8 protects the belt sleeve 7 from penetration of vapor thereinto during vulcanization.

[0021]

The vapor-impervious film 8 to be used herein is preferably a synthetic resin film of, for example, polyamides, aramides or polyesters, such as polymethylpentene, polyvinylidene chloride, polyvinyl chloride, polyethylene, polypropylene, nylon 6, nylon 6,6, nylon 6,10 or the like. Of those, synthetic resin films of polyvinylidene chloride (e.g., Saran Wrap®) are preferred, since they can easily surround the unvulcanized belt sleeve 7 without being peeled off therefrom during vulcanization as thermally shrink little, and since they can be used safely without generating any toxic gas during vulcanization.

The thickness of the film 8 is not specifically defined, but the film 8 is preferably thin as being easily wound around the belt sleeve 7.

[0022]

The mold 1 having the unvulcanized belt sleeve 7 fitted thereto while being surrounded by the film 8 is, as in Fig. 5, set in a vulcanizing device 15. In this vulcanizing device 15, the mold 1 having the unvulcanized belt sleeve 7 fitted thereto while being surrounded by the film 8 is mounted on a supporting stand 17 positioned in the lower part of the vulcanizer 16, and a cover 18 is put over the top end of the mold 1. In that condition, high-pressure vapor is introduced into the space outside the

mold 1, while low-pressure vapor is into the inside of the mold 1, whereby the unvulcanized belt sleeve 1 is vulcanized. Those high-pressure vapor and low-pressure vapor are introduced through the inlet 19, and water formed inside the vulcanizer 16 is drained away through the drain 20.

The vulcanization condition is not specifically defined, but the vulcanization temperature is preferably controlled to be such that the film 8 does not melt at the controlled vulcanization temperature. Concretely, the vulcanization temperature preferably falls between 140 and 160°C.

[0023]

Fig. 4 is a view illustrating the provision of a sealing material 22 partly over the film 8 at the upper and lower corners 12 of the mold 1, in which the upper and lower corners of the mold 1 are thus more airtightly sealed. Using the sealing material 22 as in Fig. 4, the upper and lower corners of the mold 1 are surely airtightly sealed. The sealing material 22 is rubber-impregnated canvas of spun yarns of, for example, polyamide fiber (e.g., nylon 6, nylon 6,6, nylon 6,10, nylon 4,6, nylon 12) or polyester fiber, or filament yarns of polyvinyl alcohol, polyethylene, polypropylene or the like, or cotton. This is preferably a single-layered sheet or in the form of 2-ply to 4-ply laminate. Non-woven fabric may also be used as the sealing material 22.

[0024]

After the vulcanization, the mold 1 is taken out of the vulcanizer 16, and the film 8 can be easily peeled off from the surface of the vulcanized belt sleeve 7. The used film 8 is scrapped. The belt sleeve 7 is released from the mold 1. The surface of the belt sleeve 7 is rough, as compared with that of a comparative belt sleeve as differently vulcanized using a jacket, since the belt sleeve 7 is directly vulcanized. However, the belt sleeve 7 is fully vulcanized herein without having any pores therein.

Where the belt sleeve 7 is finished into a V-ribbed belt, it is run under predetermined tension while being hung between a driving roll and a driven roll, whereupon the compressible rubber layer of its surface is ground with a grinding wheel to have ribbed hills and valleys. This grinding operation has no negative influence on the surface condition of the belt sleeve 7.

Needless-to-say, the belt sleeves as vulcanized according to the invention are not limited to only those for V-ribbed belts but can be used for other belts such as toothed belts.

[0025]

[Examples]

Examples of the invention are described below.

Example 1:

Polyethylene terephthalate fiber of 1,100 deniers in size was twisted at a count of final twist of 11.4 per 10 cm and at a count of primary twist of 21.0 per 10 cm in

opposite directions to give a core cord as twisted at a twist multiplier of 2 x 3. This cord had 6,600 deniers in total size. The raw cord was pre-dipped in an isocyanate-type adhesive, then dried at about 170 to 180°C, thereafter dipped in RFL, and finally fixed under heat at 200 to 240°C with stretching it to obtain a processed cord.

[0026]

Plain weave canvas of cotton spun yarns was used as reinforcing fabric. This was dipped in RFL, and then heated at 150°C for 2 minutes to obtain processed canvas. Next, the processed canvas was coated with a rubber composition through friction coating to obtain rubber-impregnated canvas.

[0027]

A rubber composition comprising chloroprene rubber and containing short aramide fibers was used to form a compressible rubber layer and an expansive rubber layer. A rubber composition comprising chloroprene rubber but not containing short fibers was used to form an adhesive rubber layer.

[0028]

After those materials were prepared, the reinforcing fabric, the unvulcanized rubber sheet to be an expansive rubber layer, the unvulcanized rubber sheet to be an adhesive rubber layer, the core cord, and the unvulcanized rubber sheet to be a compressible rubber layer were wound in that order around a mold having a smooth surface to give an unvulcanized belt sleeve. Next, a synthetic resin film

(Saran Wrap®) was spirally wound in a 2-ply state around the outer surface of the unvulcanized belt sleeve and partly over the both ends of the mold, and the rubber-impregnated canvas was applied onto the synthetic resin film at the upper and lower corners of the mold. The mold was set in a vulcanizer, in which the unvulcanized belt sleeve was vulcanized.

[0029]

The mold was taken out of the vulcanizer, and it was easy to peel off the synthetic resin film from the outer surface of the vulcanized belt sleeve. Inspecting the outward appearance of the vulcanized belt sleeve, it was found that the surface of the belt sleeve was somewhat rough since the belt sleeve was directly vulcanized, but was not porous at all. Thus, the unvulcanized belt sleeve was well vulcanized herein with no problem.

[0030]

[Advantages of the Invention]

As has been described hereinabove, the invention of claim 1 is a method for vulcanizing belts which is characterized in that at least the outer peripheral surface of an unvulcanized belt sleeve being fixed around a mold is surrounded by a vapor-impervious film, then the mold is set in a vulcanizer, and the belt sleeve is vulcanized under the condition that being airtightly sealed by the film. In this method, since the outer peripheral surface of the unvulcanized belt sleeve is surrounded by a vapor-impervious film, and since the film prevents the

penetration of vapor into the belt sleeve being vulcanized, the unvulcanized belt sleeve can be vulcanized without using any jacket. Therefore, this method effectively solves various problems that occur in conventional vulcanization methods using jackets.

[0031]

In the invention of claim 2, a synthetic resin film is used as the vapor-impervious film. In this, a synthetic resin film is easily wound around the outer peripheral surface of the unvulcanized belt sleeve to surround it.

[0032]

In the invention of claim 3, the vapor-impervious film is wound around the outer peripheral surface of the unvulcanized belt sleeve and over a part of the both ends of the mold. In this, even the upper and lower corners of the unvulcanized belt sleeve are surely surrounded by the film, whereby the belt sleeve being vulcanized is more surely protected from vapor penetration thereinto.

[0033]

In the invention of claim 4, a sealing material is applied onto the vapor-impervious film partly at the upper and lower corners of the unvulcanized belt sleeve. In this, the belt sleeve being vulcanized is much more surely protected from vapor penetration thereinto through its upper and lower corners.

[0034]

In the invention of claim 5, the sealing material is a fibrous one selected from at least single-layered, rubber-impregnated canvas and non-woven fabric. In this, the upper and lower corners of the belt sleeve being vulcanized are more surely sealed.

[0035]

The invention of claim 6 is a method for vulcanizing belts, which is characterized in that a synthetic resin film is wound around the outer peripheral surface of an unvulcanized belt sleeve and over a part of the both ends of a mold fitted into the belt sleeve, then a sealing material is applied onto the synthetic resin film partly at the upper and lower corners of the unvulcanized belt sleeve, thereafter the mold is set in a vulcanizer, and the belt sleeve is vulcanized under the condition that being airtightly sealed by the film. In this, the synthetic resin film used surely surrounds the outer peripheral surface of the unvulcanized belt sleeve and even the upper and lower corners thereof, and, in addition, the upper and lower corners of the belt sleeve are more surely sealed with the sealing material. This method is advantageous in that the application of the synthetic resin film and the sealing material to the vulcanized belt sleeve can be effected with ease. In addition, this method is suitable for small-space production lines, while reducing the loss of working time and reducing the cost for vulcanization.

[0036]

The invention of claim 7 is a method for producing belt sleeves for power transmission belts, which comprises forming a belt sleeve comprising at least a rubber layer and a core around the outer peripheral surface of a mold followed by vulcanizing it, and which is characterized in that at least the outer peripheral surface of the belt sleeve being fixed around the mold is surrounded by a vapor-impermeable film, then the mold is set in a vulcanizer and the belt sleeve is vulcanized under the condition that being airtightly sealed by the film, and finally the film is removed after the vulcanization. In this method, the belt sleeve can be vulcanized without using any jacket, and the vulcanized belt sleeve does not contain any bubbles. The belt sleeve produced in this method can be used in forming V-ribbed belts, toothed belts and others.

[Brief Description of the Invention]

[Fig. 1]

This is a view illustrating a step of forming an unvulcanized belt sleeve on a mold in the vulcanization method of the invention.

[Fig. 2]

This is a view illustrating the application of a film onto the unvulcanized belt sleeve formed around the mold in the vulcanization method of the invention, in which the belt sleeve is being surrounded by the film.

[Fig. 3]

This is a view illustrating the application of the film not only to the outer surface of the unvulcanized belt sleeve but also partly over the both ends of the mold in the vulcanization method of the invention.

[Fig. 4]

This is a view illustrating the provision of a sealing material partly over the wrapping film at the upper and lower corners of the mold in the vulcanization method of the invention.

[Fig. 5]

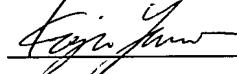
This is a view illustrating the unvulcanized belt sleeve as fitted around the mold, in which the unvulcanized belt sleeve is being vulcanized according to the vulcanization method of the invention.

[Description of Reference Numerals]

- 1 Mold
- 2 Reinforcing fabric
- 3 Unvulcanized rubber sheet
- 4 Unvulcanized rubber sheet
- 5 Core
- 6 Unvulcanized rubber sheet
- 7 Belt sleeve
- 8 Film
- 22 Sealing material

C E R T I F I C A T I O N

I, Koji Yano
of No.1-85-401,1-chome,Kaminotani,Suma-ku,Kobe-shi,Hyogo,Japan
hereby certify that I am the translator of the certified official copy of the
documents in respect of an application for a patent application filed in
Japan on January 16, 1997, application No. 019843/1997, and of
the official certificate attached thereto, and certify that the following is a
true and correct translation to the best of my knowledge and belief.


(Koji Yano)

Date this 25th day of February, 1998